

IN THE SPECIFICATION:

Please delete paragraphs [0025], [0030], and [0054].

Please combine the following pairs of paragraphs as unnecessary paragraph breaks were inserted between them: [0428]/[0429] and [0571]/[0572]

Please amend paragraphs [0019], [0024], [0042], [0046], [0049], [0050], [0052], [0053], [0060], [0061], [0102], [0105], [0106], [0108] through [0111], [0124], [0125], [0135], [0136], [0138], [0141], [0148], [0157], [0170], [0178], [0180] through [0186], [0304], [0312], [0313], [0319], [0320], [0348] through [0351], [0354], [0357], [0364], [0424], [0446], [0450], [0452], and [0462] as shown below:

[0019] A system and method for scalable multifunctional network communication between presentation devices and service providers are disclosed. A group of consumer premise equipment (CPE) units are coupled to the presentation devices, and a headend control computer (HCC) receives upstream messages from the CPE units and sends downstream messages to the CPE units. A group of service provider control subsystems (SPCS) interface between the headend control computer and the service providers. The headend control computer receives messages from the CPE units and transports them to the service provider control subsystems, and the headend control computer receives messages from the service provider control subsystems and transports them to the CPE units.

[0024] The disclosed system and method as disclosed may support a large number of CPEs--typically homes and/or businesses. There is no rigid limit on the number of terminals which may be supported in a given bandwidth. Many users with typical access patterns may be supported per Hertz of bandwidth in an efficient manner. The disclosed system and method allows the practical and effective use of a wireless media to reach a large number of users from a single hub with a general purpose high-bandwidth two-way digital connection. The broadcast spectrum in the range of 50 to 800 MHz may be

such a medium. With the disclosed embodiments, capacity is used efficiently. When a network is operating at the traffic load level for which it is designed, with reasonable fluctuations around this load level, such traffic loading called herein later the Operating Point of the subject network, the uplink channel capacity is used with efficiency between 90% and 100%. Efficiency may be inherent for some applications because these applications may ~~avoided~~ avoid dedicated assignment of capacity to users during transactions, such dedicated assignments usually being called circuits. Efficiency may be augmented by the distributed control of the disclosed method, which limits control traffic overhead.

[0042] Referring now to the drawings, and more particularly to FIGS. 1A, 1 and 2 thereof, a scalable multi-functional network communication system 10 is constructed in accordance with an embodiment of the present invention, and enables communication to occur between a group of consumer premises, such as consumer premises 12, 14, 16 and 18, over a widely distributed geographical area. Each premise or building houses a CPE 21 which includes a CPE control computer 22. The CPE 21 is connected in communication with at least one presentation device as is generally indicated at 23. The display devices 23 may include a television set 25 connected via a subscriber interface module (SIM) ~~[[26]]~~ 30 to the CPE control computer 22. Similarly, a personal computer 27 may be connected via an SIM 28 to the CPE control computer 22, and a telephone set 29 may be connected through an SIM ~~[[28]]~~ 26 to the computer 22. There may also be other presentation devices 32 each of which is connected by an SIM 33 to the CPE control computer 22.

[0046] At the HCC ~~[[21]]~~ 38 (FIG. 1), when messages are received via the receive router 65 from the CPEs, they are sent from the router 65 to message receive queues generally indicated at 70, where their contents are either eventually transferred to a internal control processes (such as that overseeing the Master IR Pool 71) or to one of

the SPCSs such as the SPCS [[43]] 45 each of which SPCSs having at least one I/O Receive Queue 73.

[0049] A master clock 85 controls the operation of the HCC [[41]] 38. The CPEs are synchronized to this clock.

[0050] At the CPE, as best seen in FIG. 2, a receive router 74 receives messages from the HCC [[41]] 38, and transfers them to message receive queues 77. Service messages are transferred directly from the message receive queues 77 to the SIMs such as the SIM 26.

[0052] The control messages that are received in the Control message receive queues such as certain of those indicated in 77 are transferred to various internal control ~~applications~~ applications 76. In particular, an RQUM is routed to a queue that carries, among possibly others, messages destined for the request queue insertion algorithm 79. The RQ Insertion Algorithm 79 places the IRs contained in a received RQUM into the local request queue (Local RQ) 78. The Local RQ 78 serves to sequence a transmission scheduler 82 for sending messages upstream to the HCC [[41]] 38.

[0053] The Transmission Scheduler 82 has a second function. It places requests for specific sized upstream intervals to be used to send particular messages. These requests are formatted as IRs and collected in the Local IR Pool 88 until such time as upstream space is available for requests to be sent to the HCC [[41]] 38. An upstream space to carry a request is called an Aloha slot. A burst of Aloha slots occurs from time-to-time on the upstream. This burst, formed within a single interval, is called an Aloha slot burst interval (ASBI). The Transmission Scheduler 82 places one or several requests in an ASBI, in slots that it picks at random.

[0060] The transmitted telephone call packet IRM may suffer damage from contention by other IR senders or from noise. In either case it may not be received at the HCC 38 and thereby its IR will not enter the Master IR Pool 71, and will not be received back at the CPE ~~[[38]]~~ 21 in an RQUM. The requesting CPE will know when this IR should arrive in an RQUM (or perhaps in any one of a set of RQUMs, depending on the embodiment), When the requesting CPE ~~[[38]]~~ 21 determines that it's IR has been missed, it reverts to a suitable contention resolution algorithm which may include the resending of the IR. IRs transmitted by a CPE ~~[[38]]~~ 21 may be saved for possible resending until safe reception is confirmed.

[0061] At the headend HCC 38, the IRM containing the subject IR request is received and enters the IR is unloaded from the IRM and placed in the IR Pool 71. Once the headend HCC ~~[[41]]~~ 38 determines that all 64 mini slots have been received, then the slots containing information such as the IR request from the CPE 21, may be, if desired, ordered and arranged according to any desired algorithm. Assuming, for example, that only 30 of the 64 mini slots contain messages, all 30 of the messages are transferred to the message transmit queue 80, together with other IR messages, if any, from the IR pool 71. Thus, the sequence of IR messages ~~[[are]]~~ is then transmitted downstream to each one of the CPEs ~~CPEs~~ and a copy of the sequence is placed in the master request queue 72.

[0102] Referring now to FIG. ~~[[3A]]~~ 3.1, a channel is a dedicated physical media that may carry a stream of symbols. In Networks using the disclosed method, channels are divided in time into intervals. In the preferred embodiment these intervals are contiguous, one interval following immediately after another intervals on the downlink and on the uplink have varying lengths as determined in real-time by the HCC control circuitry. In the preferred embodiment downlink and uplink are carried on different channels. An alternative embodiment comprises downlink and uplink information

carried on the same channel.

[0105] Messages are transmitted in intervals and slots. There is at most one message per interval unless the interval is partitioned into slots. In this case there may be at most one message per slot. For the preferred embodiment, as shown in FIG. ~~[[3A]]~~ 3.1, timing is maintained to an accuracy that allows symbol boundary tracking across interval boundaries, and no gap is required in the interval to account for timing uncertainty in placing the message. In addition, the preferred embodiment includes continuous downlink transmission with coherent symbol modulation from one message to the next.

[0106] Message headers and related subparagraphs are shown in all messages in FIG. ~~[[3A]]~~ 3.1. These message headers are shown to include acquisition sequences, which are used to support acquisition by the receiving terminal of the attributes of the modulation in the Physical Layer message headers are required in the disclosed method in downlink messages. Acquisition sequences are only required in some messages on the downlink, their exact location depending on the requirements of a particular embodiment.

[0108] FIG. ~~[[3B]]~~ 3.2 emphasizes that in the disclosed method, a message header may not be needed in most messages on the uplink for the HCC to know the attributes of the Message. Information, required in the method, need not be in message headers on upstream messages because said required information has been previously transmitted in an IRM to the HCC. Thus, the only purpose of an uplink message header, if present, may be to support acquisition. With some media, this is not necessary. With all media, if symbol boundary tracking is maintained across an interval or slot boundary, acquisition using data in the message body may cause a high error rate over only the first few symbols of a message, but coding and interleaving may be used to recover this

data, thereby allowing the exclusion of a message headers. This discussion also applies to consideration of removal of acquisition aiding sequences on downlink messages. However, on downlink messages, certain data must be present in the message header for the CPEs to successfully capture and route the message.

[0109] FIG. 3.3 illustrates an embodiment that has gaps in the intervals. By excluding message headers, it is implied in the diagram that this is an upstream channel. Downlink channels can also allow similar gaps in this type of embodiment.

[0110] FIG. 3.4 illustrates a channel arrangement in which messages are placed in intervals and slots that have guard spaces, and the messages have message headers that support acquisition of each message. The guard space allows the messages to be transmitted with somewhat inaccurate clocks, as might be found on the uplink in an embodiment with the goal of supporting a Network with low-cost CPE terminals. Clock inaccuracy in the CPE may also be found in Networks where transmission on the downlink is intermittent, thereby creating an environment where the Local System Clocks can drift from the value of the Master System Clock. This embodiment is also appropriate on the downlink in the case that terminals are often joining and leaving the Network, or where transmission by the HCC is intermittent.

[0111] Referring now to FIG. 4, messages are carried on the downlink. Downstream messages have a message header and a message body (see-Claim-110-with-its-subparagraphs). The message header may contain a DTA data structure. The subject embodiment must have continuous transmission of messages on the downlink (at least so far as the set of messages carried between messages that contain DTA data structures), and maintain symbol alignment across message boundaries (i.e. the boundary of the end of the last symbol in a message coincides in time with the boundary of the first symbol of the next message). It is important, but not essential to

the method described herewith, that the embodiment maintains phase coherence from one symbol to the next across message boundaries in those network channels where such a demodulation method is germane.

[0124] Referring now to FIG. [[6]] 6.1 or 6.2, data elements are coded as indicated in the drawing. For the sake of clarity, message headers do not contain control information used by service elements. White is used for the background or unspecified data in an interval request.

[0125] The interval request (IR) format is presented in FIG. [[6]] 6.1 or 6.2. One and only one IR is associated with every uplink interval, called the associated interval. The associated interval is typically used to hold one and only one message called the associated message. The IR format contains fields of data common with those designated for a message, with the exception that the interval Length of an IR may be longer than the message length of the associated message. The Transmission Scheduler forms the IR; the said application utilizes the IR to make a request for an associated interval. Aside from the typical case where an interval is requested for the purpose of sending a single message, an interval may be requested by one CPE for another or by the HCC for a CPE, or by any of these for an interval with slots to be used in a more complex way as determined by control applications, SCPCs, or SIMs working with a Transmission Scheduler control application. An example is the IR established by the Request Manager at the HCC for the purpose of requesting an ASBI on the uplink.

[0135] IRs are transmitted on the uplink in IR messages as shown in FIG. [[6]] 6.1 or 6.2. Such messages have a message header in a typical embodiment, although applications in which a message header is not required are foreseen.

[0136] Referring now to [[7]] FIGS. 7.1 and 7.2, there is shown the Request Queue. The

representation for RQ indicates that the top of the queue is on the right. This is where elements are removed from the queue. They are put into RQ at any point, depending on the RQ Insertion Algorithm.

[0138] The interval request (IR) format is presented in FIG. ~~[[6]]~~ 6.1 or 6.2. interval requests arrive in RQUMs at the HCC RQ Insertion Algorithms. These RQUMs are created locally in the HCC by the Request Manager, and forwarded to the RQ Insertion Algorithm simultaneously with being placed in an HCC message transmit queue.

[0141] The top element of the RQ is discarded once its IR Transmit Time has passed as per note (g) above. The interval request (IR) format is presented in FIG. ~~[[6]]~~ 6.1 or 6.2. Interval requests arrive on the downstream in RQUMs at the CPE and are forwarded to the RQ Insertion Algorithms.

[0148] In the period after the time for updating the RQs, the HCC RQ and the CPE RQ are in condition to be compared. When it is stated ~~in the Claims~~ that the RQs meet certain conditions when compared, it is meant that the comparison is between the two RQs during the time intervals in FIG. 8. If the CPE has been in RQ Synchronization and the RQUM referenced in FIG. 8, the CPE remains in RQ Synchronization. If the CPE does not receive the RQUM at the expected time, as indicated, the contents of the Local RQ diverges from the contents of the Master RQ and the CPE falls out of RQ Synchronization.

[0157] ~~Refer to Claim 30 with its subparagraphs.~~ The Transmission Scheduler thereafter monitors the IRs received on RQUM, or equivalent, seeking to find that the IR that it has transmitted has been forwarded by the HCC. This wait goes on for a fixed time period or a fixed number of RQUMs depending on the details of implementation.

[0170] Referring now to ~~FIG. 3A~~ FIGS. 3.1 through 3.4, timing diagrams are ~~present~~ presented for the use of a channel in the disclosed embodiment of the inventive method. FIG. ~~[[3A]]~~ 3.1 depicts a typical format for channel use, on the uplink or downlink. FIG. ~~[[3B]]~~ 3.2 illustrates an uplink format with messages formatted to not contain message headers. FIG. ~~[[3C]]~~ 3.3 illustrates that there can be gaps in interval sequences in the disclosed embodiment. FIG. ~~[[3D]]~~ 3.4 illustrates the format of a channel in an embodiment with Guard Bands.

[0178] Referring to ~~FIG. 6~~ FIGS. 6.1 and 6.2, the format for the data structures associated with the interval request are presented. FIG. ~~[[6A]]~~ 6.1 or 6.2 presents the interval request (IR). FIG. ~~[[6B]]~~ 6.1 presents the interval request message (IRM). FIG. ~~[[6C]]~~ 6.2 presents the Request Queue Update Message (RQUM).

[0180] The IR may contain control information specific to a particular embodiment of the present invention, such information being placed in the Other Control Information field. Specific optional control information claimed in variants of the disclosed embodiment of the method. As shown in FIG. ~~[[6A]]~~ 6.1 or 6.2, Birth Time, IR Age, IR Transmit Time, and IR Counter may be included. IRs may be created by control applications or by the Transmission Schedulers of CPEs. For uplink transmission IRs are encapsulated in IR messages (IRMs).

[0181] As shown in FIG. ~~[[6B]]~~ 6.1, IRMs may or may not have message headers depending on the embodiment. IRMs are transmitted into Aloha slots of Aloha slot burst intervals. The transmission is ad hoc and may contend in the transmission period, destroying both. It may take several transmissions before an IRM is successfully transmitted to the HCC.

[0182] The HCC transmits a set of IRs on a downlink message called an RQUM. The

format of the RQUM is shown in FIG. ~~[[6C]]~~ 6.2. The RQUM message header may have control information specific to a particular embodiment carried in its Other Control Information field. The RQUM message header may carry data used to synchronize the RQ in the CPEs. It may carry RQ Depth and RQUM Top Time fields for this purpose. It may also carry an RQUM Counter field, whose value is used in managing RQ Synchronization.

[0183] As shown in ~~FIG. 7~~ FIGS. 7.1 and 7.2, RQ is a single queue. IRs are the elements of RQ. The RQ Insertion Algorithm at both the HCC and the CPEs places these in RQ.

[0184] The elements of RQ (the IRs) progress to the right in ~~FIG. 7A~~ FIGS. 7.1 and 7.2 as time goes on. The far-right element may be said to be at the top of the queue. The RQ Insertion Algorithm need not place new elements at the bottom of the queue. Elements may be placed in the queue so that higher priority, or delay sensitive, IRs may be placed higher in the queue. There is a requirement on the placement algorithm that elements placed in the queue reach the top in reasonable time, but other algorithms may also be employed.

[0185] As shown in FIG. ~~[[7B]]~~ 7.1, at the HCC, the Master RQ simply serves as the record of the state of the uplink. This information is used as a basis for synchronize information sent to the CPEs. It is also used by internal Control Algorithms in managing the uplink through various means.

[0186] As shown in ~~FIG. 7C~~ FIG. 7.2, the CPE, the Local RQ serves as the record of the state of the uplink. This information is used to determine when the CPE may transmit on the uplink. The CPE has an RQ Synchronization Algorithm that establishes the

synchronization of the Local RQ with the Master RQ--i.e. forms the Local RQ so that it is substantially identical with the Master RQ--and monitors this synchronization.

[0304] The Headend Control Computer (HCC) [[21]] 38 may comprise a set of databases and applications located at a central site. The HCC is the sole source of communication system data sent to the distributed terminals on the Network, and the sole destination of communication system data sent from the distributed terminals on the Network, and, further, the HCC [[21]] 38 causes the data to be sent and received by means of the methods, protocols, techniques, formats, and processes as disclosed herein. The linkage on the Network that supports data flow from distributed terminals to the HCC is described herein as uplink. The linkage on the Network that supports data flow from the HCC to the distributed terminals is described herein as downlink.

[0312] The system 10 and method provides a Service-Message Admission Control Function (SACF) that is one of the functions carried out by the SPCSs and SIMs at the interfaces to the HCC and CPEs, such SACF with the function of disciplining or policing message traffic offered to the Network so that this traffic has the statistical or average properties required by the BSDP embodiment. The properties include, but are not limited to, some or all of the following: (1) average message length, and (2) average rate of messages (~~see Claim 10 with subparagraphs~~). In order to support the SACF function, service applications, or control applications acting to support a Service, can communicate among themselves using Service-specific control information transmitted within particular types of service messages. FIGS. 1 and 2 depict the role of the SACF function at the SPCS and the SIM in regulating message flow to the network.

[0313] The system 10 and method for a Network may share one or more channels using Time Division Multiple Access (TDMA) are claimed when integrated into the system structures. ~~FIG. 3 presents~~ FIGS. 3.1 through 3.4 present the physical

organization of channels in the disclosed method.

[0319] For the FDD channel organization, upstream intervals are in a contiguous sequence with the ending time of one interval serving as the beginning time of the next interval; and downstream intervals are arranged in a contiguous sequence with the ending time of one interval serving as the beginning time for the next interval. An alternate also claimed is that unused gaps are allowed between intervals in either uplink or downlink channels, or both. ~~FIG. 3 depicts~~ FIGS. 3.1 through 3.4 depict the arrangements of intervals in channels.

[0320] For the TDD channel organization, intervals are arranged in a contiguous sequence with the ending time of one interval serving as the beginning time of the next interval, but each interval may either be an uplink or a downstream interval. An alternate claimed is that unused gaps are allowed between intervals in the TDD channel organization. ~~FIG. 3 contains~~ FIGS. 3.1 through 3.4 contain examples of the use of intervals in channels, and is incorporated herein by reference.

[0348] Control applications which reside either in the HCC or the CPE CC (FIGS. 1 and 2) organize, and direct to be transmitted, control messages; such control message being a type of message. Control messages are directed to control applications. Certain embodiments may include control messages associated with: (i) CPEs joining the Network including Registration and determining CPE Offset (~~see Claim 26 and subparagraphs~~), (ii) establishing and supporting various priority and categorization arrangements, (iii) updating control algorithms, (iv) synchronizing encryption systems, (v) modifying or varying modulation and other physical layer modes, and (vi) supporting other management and control functions as deemed necessary by the specific implementation designer. For any given embodiment, there is a required set of control message types and associated data types, as defined here below, that are present.

[0349] An interval request (IR) (FIG. ~~[[6]]~~ 6.1 or 6.2). The IR data structure is used to convey a request for an interval of uplink channel capacity. The upstream interval associated with an IR is called the Associated interval. An IR associated with an upstream interval is called the associated IR. Every interval has one and only one Associated IR. If the interval does not have slots, it is then associated with one and only one message (~~see Claim 5(c)~~), such message being called in this case the associated message. Certain key interval characteristics, as depicted in ~~Drawing 6~~ FIGS. 6.1 and 6.2, are recorded in the IR. Every IR has an interval Length field, which defines the length of the Associated interval in terms of a convenient measure (~~see Claim 10(c) for the comparable message length field of a message header~~). For the sake of clarity, because of the presence of Guard Space, interval Length for an associated interval may be larger than message length for an associated message, or larger than the combined message lengths for a set of messages to be placed in slots in a single interval. The IR contains Address, application ID, and Type and Priority fields. The combination of these three fields may be used in an embodiment to convey the control information needed, at the MAC layer, to organize distinct and separate message transmissions into slots of a single interval. The IR may contain Other Control Information ~~as per Claim 10(g)~~.

[0350] The IR is present in several different control message types--to wit at least in the IRM and the RQUM, and is the element, or provides information for the element, carried in the Request Queue. For the sake of clarity, an RQ element may contain a data structure comprising a part of the IR information, all of the IR information, or independent information plus some or all of the IR information, depending on the detailed design of the embodiment. However, the RQ element must, as a minimum, contain the Address and interval Length from the IR on which it is based (~~see FIG. [[6]]~~ 6.1 or 6.2). For the sake of descriptive convenience, the RQ elements are also called

IRs. There is one and only one RQ element created for each IR received by the RQ Insertion Algorithm application. Each IR as an element in the RQ has associated with it a Transmit Time data element, such time being the best estimate by the RQ Insertion Algorithm of the time that the associated message (whether local or not) is to be transmitted. When reference is made herein to the Transmit Time of a message, as such Transmit Time is carried as the value of a data element associated with said message's Associated IR; it is called the IR Transmit Time. The Transmit Time is a field of the IR added by the RQ Insertion Algorithm when modifying the IR for placement in the RQ. Transmit Time is measured in terms of the system clock of the terminal--in terms of the Master System Clock for the HCC, and the Local System Clock for each of the CPEs.

[0351] An interval request message (IRM) is a control message that carries, on the uplink, an interval request from a CPE to the HCC. The IRM is of fixed length. The IRM is of variable length. The IRM is depicted in FIG. [[6]] 6.1.

[0354] A Request Queue Update Message (RQUM) is a control message that is a variable length downstream message originating at the HCC that contains variable number of interval requests and, possibly, additional control data in the Body of the message. FIG. [[6]] 6.2 presents an example RQUM structure and is incorporated in this claim by reference.

[0357] The Other Control Information field of the message header of an RQUM is null, or containing control information particular to an individual embodiment. The Other Control Information field contains, as a sub-field or as the whole field, a data field called an RQUM Counter (FIG. [[6]] 6.2) which provides information that allows a CPE to determine that an RQUM has been missed, and example of an RQUM Counter is a field of some fixed number of bits which is incremented circularly (i.e. after the largest

number is reached, the next increment is to 0) for each RQUM transmitted. The Other Control Information field contains, in a sub-field or the whole field, a DTA Data Structure.

[0364] The Request Queue (RQ) is a distributed data structure. It is depicted in ~~FIG. 7~~ FIGS. 7.1 and 7.2. RQ is formed as follows: The version of the Request Queue carried in the HCC database is called the Master Request Queue and is the correct and accurate version of the Request Queue. Each CPE carries an estimate of the Master Request Queue called the Local Request Queue, which can be different from the Master RQ even though the BSDP method provides the means for the CPE to maintain the Local RQ as a copy of the Master RQ. The local RQ can be different because for some amount of time the CPE does not receive information from the HCC needed to keep the Local RQ identical to the Master RQ. RQ is a single queue of interval requests, including a mix of IRs for service messages and for control messages. The size of RQ is set to support variations in message rates on the upstream.

[0424] In certain variants of the RQ Synchronization Algorithm, a record is associated with each IR of RQ, said record being called the IR Age (FIG. ~~[[6]]~~ 6.1 or 6.2), the IR Age for a particular IR is initiated by the RQ Synchronization Algorithm upon receipt of said IR (in the HCC and in all CPEs). The IR Age for a particular IR is initiated at zero value in the HCC at the time that the RQUM, that contains said IR, is sent. The IR Age for an IR received at a CPE is initiated at the CPE Offset value. The IR Age associated with each IR of the RQ in a terminal is incremented at the same time and by the same amount by the RQ Synchronization Algorithm, or equivalent functionality, said incrementing process to be performed at comparable times in the CPE and the HCC as determined (FIG. 8). If the measure used for IR Age is time, said increment will be by the elapsed time since the last increment. (In the variant here cited above, this would be the elapsed time since the last RQUM.) All methods using IR Age when used as a

part of the RQ Synchronization Algorithm, are claimed. A variant of IR Age is claimed in which the measure of age is in terms of number of RQUMs that have been created and transmitted since the initial placement of an IR, the CPE IR Age and the HCC IR Age being initiated in said variant at the same number (1 or 0 are appropriate choices), and are incremented by "1" each time that an RQUM arrives at the RQ Insertion Algorithm.

[0446] As shown in FIG. 10, IRs are distributed from a Local IR Pool to the distributed RQs. The Transmission Scheduler, or functionally equivalent, in a Synchronized CPE timely selects, from the Local IR Pool, an IR (FIG. [[6]] 6.1 or 6.2) to be transmitted. The method of selection is in accordance with any suitable algorithm. The Transmission Scheduler algorithm may be employed to select an IR for transmission, and determines the order of IR selection for transmission based on characteristics of the IR, possibly including the time that the IR was created or that the associated message arrived. The Transmission Scheduler, or functional equivalent, creates an IRM (FIG. [[6]] 6.1) to carry the selected IR, and places this IRM in a message transmit queue.

[0450] Multiple IRs are in Distribution and their Associated IRMs are in the same IRM Holding Pen during the same time period, said IRMs possibly being associated with the top messages of several queues or with multiple messages in one queue or a combination thereof, and, further; in said extension a means is provided to distinguish without possible ambiguity, by means of the contents of the IR, the associated message for that IR. A counter, called the IR Counter, is included in the Other Control Information field of the IR (FIG. [[6]] 6.1), such IR Counter to contain a value incremented (modularly, in a circular method, as determined by field size) from that of the IR Counter value of the previous IR formed in the same CPE. For the sake of clarity, the purpose is to provide a means for a CPE to have multiple IRs in Distribution in the system 10 at one time, and to easily and surely avoid confusion as to which associated message is attached to a specific IR in RQ. The system 10 allows high-priority mMessages

messages to move ahead of lower-priority message during the IR Distribution Process.

[0452] As CPE can form an IRM to request an interval to be used by another CPE to transmit a certain message or message type, as designated by the application ID and Type or Priority fields of the IR (FIG. [[6]] 6.1), such arrangement requiring pre-arranged, cooperative, or associated, means and methods on the part of an SPCS and/or BSDP control applications to have practical value. A CPE can form an IRM to request an interval that is meant to support contending transmission attempts.

[0462] The detection of Duplicate IRs is by means of the IR Counter of Claim-28(f); said detection providing the means for the RQ Manager to remove Duplicate IRs from Distribution. The detection of Duplicate IRs is by means of the IR Counter. The RQ Insertion Algorithm does not enter Duplicate IRs into RQ.